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REPORT

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FISH OF THE GREAT MIAMI RIVER
10 SEPTEMBER 1987

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FOR

Westinghouse Materials Company of Ohio
Cincinnati, Ohio

DATE: 10 SEPT. 1987

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INTRODUCTION:

Electrofishing with pulsed DC is amongst the most efficient methods of collecting fish samples unbiased as to species or size (Yoder et al. 1978). In turbid water the fish collected are those which break the water surface sufficiently for the collectors to respond with their nets. Many fish are lost, hence the method is best reported as the number/species richness collected at a given station per unit collecting time or per kilometer of shoreline. The collections are presumably comparable for density in the collectable habitat. However, the density per unit of shoreline is not an absolute density except in very small channels. The density of fish and diversity collected are a function of the number of fish, depth, suitability of the shoreline habitat for fish, water clarity and skill of the operators.

This report presents the data from a one day electroshocking trip at three stations on 10 Sept. 1987 above and below the introduction of potential aqueous effluents from the Westinghouse Materials Company of Ohio at Fernald, Ohio. The stations were located above any effluents, at the outfall of an effluent pipe from Westinghouse, and below a stream which could bring drainage from the property. The report will present the data from 1987 and compare those data with the comparable data from previous years.

METHODS: Fish were electroshocked with a 240 volt, pulsed DC at 60 cps electroshocker with 10' boom mounted on a 16' john boat. For the anode, the shocker used 2-3 vertical cables with 4-5" of wire exposed and hanging at about

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6" in depth. For the cathode 5 large flexible cables were attached to the front of the boat, trailing under water at least 2 feet. The Onan generator provided 3500 Watts @ 120VAC (29amps). The shocker worked with about 4.0-4.2 amps delivered from the anode to ground (cathode) in water of this conductivity. Two persons on the front of the boat caught fish with 10' long dip nets, as the fish lost their equilibrium from the immobilizing current of electricity. Fish were placed in a central well during 45-70 minute shocking sequences. At the end of a zone or when enough fish had been collected for a suitable sample, the fish were identified to species, weighed in grams (+- 2 gms) and lengths taken in millimeters. The fish were placed on ice in plastic bags and returned to the Department of Biological Sciences, University of Cincinnati, where they were refrigerated overnight.

The next morning the fish were reidentifed for confirmation where necessary with appropriate keys and their viseral cavity opened to determine sex where possible by presence of ovaries filled with eggs or testis tissue at the back of the body cavity. They were reweighed and lengths retaken. The specimens were decapitated and eviscerated. The fillets of fish weighing normally > 400 g, were placed in plastic zip loc bags, and marked by species, sex, and weight contained therein (see Appendices 1,2 & 3). These bags were numbered, grouped by station in a larger bag and frozen at 20C and stored for shipment. Fish from each station were handled at one time. The area was then cleaned and fish from the next station processed completely so that cross contamination between stocks could not occur.

For shipment the fish were placed in styrofoam freezer chests with 10 lbs of dry ice. They were shipped by Federal Express to the laboratory specified by Robert Keys and Chris Aas. Inventory lists, coded when the samples were prepared, were transfered to FMPC Analytical Data Sheets and sent to Chris Aas. The same data was transfered to FMPC Custody Transfer Record Work Request forms and included with the shipped fish samples.

at the Boulton Water Works site, Stricker's Grove site and Welch Sand and Gravel (Paddy's Run) site, respectively on 10 Sept. 1987.

Physical-Chemical measurements taken included dissolved oxygen with an air calibrated YSI MODEL 57 meter(Yellow Springs, Ohio), conductivity with a YSI MODEL 51 meter and probe. The percent oxygen saturation reported assumes 1 atmosphere of pressure at the ambient river temperature taken from Wetzel and Likens (1978). Depth of the pool was sounded frequently with a marked pole from the stern while shocking by the driver.

ELECTROFISHING STATIONS:

Three started stations were examined on the Great Miami River. The first station at the Boulton Water Works, City of Cincinnati was above Westinghouse Materials of Ohio probable effects area (Station 1 at RM28). The site is a straight section of pool just in front of a rapid. A backwater thumb projects under a good riparian cover behind the bar that forms the rapids. This may have the best riparian cover of any of the stations. However, the current velocity here is nearly as slow over most of the section as station 3. The second station at Stricker's Groove Park is the immediate area below the outfall of the WIMCO effluent pipe (Station 2 RM24). The habitat on the west shore is optimal, steep sided, fairly rapid current, some riparian trees standing and fallen into the river to provide cover. This station is on the outside of long curve, thus the other side is a depositional cobble bar, which was shallow, unprotected, and had variable current. Station 2 was the fastest current velocity on average of the three stations at the front of a two part rapid. The

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Third station at Welch's Sand and Gravel (on East Miami River Road) was in a deep pool created by 25 years of gravel dredging (RM 19.3) at the junction of Paddy's Run and the Great Miami River. This pool began at the foot of a rapids, instead of on top of one. The channel had one natural shoreline where most of the fish species were to be found. The steep, sandy gravel pit side had not riparian vegetation or structrual diversity and was unattractive to all but gizzard shad. A barrier dam created to protect a Cincinnati Gas and Electric Company pipe(1986) had been completely removed in 1987.

RESULTS:

Physical/chemical data taken on 10 Sept. 1987 to examine any gross differences between water quality at each station revealed little difference between stations that could have caused changes in distribution of fish species. Other macrohabitat differences in current, substrate, eddies, riparian vegetation and presence of large barriers underwater were more likely to have caused the distribution found.

Table 1: Physical/chemical data from electroshocking stations 10 Sept. 1987

Parameter		Oxygen ppm	Percent Saturation	Temp. °C	Conductivity umhos/cm	Avg. Depth of pool
Station 1 @ 9:00						
River		7.35	101%	22.25	950	0.75 m (0.3-1.5)
Backwater		8.85	84.5%	21.25	900	
Station 2 @ 11:30						
River		8.50	99.2%	23.0	900	1 m (0.3-1.5m)
Station 3	0 m	7.8	93.7%	24.5	990	2 m (0.5-2.5m)
@ 16:30	1 m	7.4	88.9%	24.5	990	
	2 m	7.2	85.5%	24.0	990	

The Great Miami River on one of its days of minimum flow for the year is productive with oxygen saturation holding above 85% at all stations. The temperature increase is the diurnal heating between 9:00 - 16:30, probably not due to a thermal effluent. Only the conductivity is high. Conductivity in mid summer in equilibrium with limestone bedrock may reach 600 umhos/cm. These values of 900+ umhos probably reflects the addition of salts by several sewage treatment plants along its course. They add monovalent salts of sodium and potassium which are very, very soluble at these temperatures. The average depth of pool around which we electroshocked appeared to become deeper downriver. The pool depth is not a good estimator of the depth from which fish are caught. The fish must be attracted by the anode to the surface for the persons with nets to see the fish. Thus the bow of the 16' Appleby was usually working very near shore in only a few decimeters of water.

The number of fish caught was nearly constant except at station III (Paddy's Run) where we electroshocked for 70 minutes (2.54 km shore line) where diversity was low compared to previous years. Some 51, 56, and 119 fish were collected and processed at stations I, II, and III, respectively (Table 2, Fig. 1). This was a comparable density 35, 40 and 47 fish netted/kilometer of shore line. The number of species collected or observed was 10, 11 and 10 at the three stations, respectively (Table 2, Fig. 2). However a short nose gar was seen, not collected at station 2 making the total 12 species. The gizzard shad, Dorosoma cepdianum (Clupeidae) was dominant at stations 1 and 3. The freshwater drum Aplodinatus grunniens was most common at station 2. Only gizzard shad, carp and stripped bass Morone saxatilis (Serranidae) were found at all three stations. Hence the remaining 19 species identified were found at only one or two stations. The coefficient of community is defined as $CC = 2c/(a+b)$, where c is no. of spp. in common between two stations, a and b are no. of spp. at station s being compared. The CC is the proportion of species that the two communities share ranging from 0 for complete dissimilarity to 1 for identical species arrays.

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Coefficient of Community between stations 1, 2, and 3.

Station	1		2		3
Coef.Commun.	I	.571	I	.476	I
	I		.300		I

The fish species from stations 1 and 2 are more related than those from 2 and 3, and 1 and 3. There would appear to be a gradient of species replacement from upstream to downstream.

The Shannon-Wiener diversity ($\log_2$) was highest at station 2 (3.07) compared to stations 1 (1.68) and 3 (1.26)(Fig. 3). The Shannon-Wiener diversity index is sensitive to both the number of species in the collection, but also to the equitability of the individuals amongst the species. That is, a sample with equal representation of individuals in every species will have a much higher diversity index value than a sample with the same number of species with only one individual in all species except a common one. The measure of equitability is the eveness index (Table 2) which ranges from 1 to nearly 0 for samples with the same number of individuals per species in the first case, to nearly all individuals in the same species in the second case. The eveness at station 2 was 0.89 compared to 0.51 and 0.40 at stations 1 and 3, respectively. Hence station 2 was the healthiest, followed by station 1 and then station 3. The number of fish caught was a reflection of density and sampling time. Twice as many fish were captured at station 3, a uniform deep pool in an active gravel mining area at the mouth of Paddy's Run Creek (Fig. 1). Because of the numeric dominance of gizzard shad and the apparent paucity of other species, we collected at this station 3 in 70 min. compared to only 42-45 minutes at stations 1 and 2. Hence the collection rate was about the same per unit time.

In addition to comparing the diversity and species richness for each station, we can ask where the size or biomass of fish is the greatest and how distributed by size between stations. If one station is severly polluted compared to another, it may contain only large individuals of a few species with very few young since the eggs and young are more sensitive to stress than are the adult fish of most species. Or if a toxicant has killed the older fish in an episodic pollution event, there may be only samll individuals recolonizing a stretch of river. Given the same species pool at each station then, then only large fish or only samll fish may indicate a stressed habitat for fish. Electroshocking does not collect all sizes with equivalent efficiency, since the accuity of the person netting is involved, his or her eye being drawn, perhaps, to the larger form, given multiple fish present at the same time. Thus, the human collector might be prone to larger fish, often missing a samll species all together. Electroshocking ls also more effective against large than small fish, all other things being equal (Vibert 1967, Moller 1986).

Thus we plotted the frequency distribution of all fish per station by length (Fig. 4) and weight (Fig. 5). The mode for all stations was the same, about 260 cm. Station 2 obviously had more large fish than other stations; however, the fastest currents also occured here so that size and swmimming speed would be important. The highest percentage of modal-sized fish (40%) was found at station 3, where gizzard shad dominated the assemblage (Fig. 6). The frequency distribution by weight showed that station 1 had the largest fish, followed by station 2 and station 3 (Fig. 5). The percentage distribution by weight was most uniform for all sizes at station 2 with only 13% in the modal category (Fig. 7). Rather than interpret this increase of fish size at station 2 and decline at station 3 interms of a pollutional stress, more likely these differences are due to habitat and current regimes at the three stations in 1987 compared to 1986. The stations were chosen for their proximity of launching sites and to effluents of interest for possible radionuclide concentration.

Finally, a plot of cumulative percentage of fish by length and weight clearly show the differences between stations. The cumulative precentage frequency by length (Fig. 8) show that station 3 has the smallest fish with few

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large fish in our sample (median = 230 mm). Station 1 had many small fish (median = 260 mm) but many larger fish as well. Station 2 had the largest median fish (median = 280 mm) but, fewer large fish than station 1. Since weight of fish is allometrically a cubic function of length, these differences in length are even more pronounced on the cumulative percentage distribution by weight (Fig. 9). Station 3 had the smallest median (130 gms) with its dominance of gizzard shad, followed by station 1 (180 gms) and then station 2 (260 gms). The weight of fish from station 2 appeared to be almost equal at each size class compared to the other stations. Many more intermediate sized fish and fewer small fish were collected here, again reflecting the rapid current and perhaps the inability of smaller fish, especially shad, to maintain position in the current.

Only two species of fish were collected in sufficient numbers to compare the length/weight relationships between stations. Carp were collected at stations 1, 2, and seen but not collected at station 3. If the apparent curves overlie one another, then there is no difference in condition factor, that is weight per unit length. The carp are equivalent between these two stations (Fig 10). The largest sample of any species at all three stations was the gizzard shad and their length x weight distribution similarly shows overlap, with the station 3 having the only small individuals (Fig. 11). However, above 120 gm where all stations have representative specimens, the shad from all three stations appear comparable in health. At station 3, the young of the year would have had the best chance to develop in large numbers. With the dry summer and pooled conditions they could maintain their position in the river. A lake population in a stressed shallow water system (Winton Lake, Cincinnati) had much thinner, lighter shad per unit length than those in the Great Miami River in 1986. Thus the shad appear to be very healthy in this environment. Their numerical dominance may be some indication of that ability to grow on an organic detritus.

Breeding males and females are readily separated by such an examination. However, immature or nonbreeding females have undeveloped ovaries which can look very much like testis. Hence any errors in sex determination should bias males. Summing all for the more common fish from all stations, namely shad, carp, all suckers, and stripped bass, the sex ratios (M/F) ranged from 1 to 2.5. Sample sizes are small, thus the addition of one individual can influence the final ratio. Sex ratios in bisexual populations that deviate from 1 can be and indication of stress. None of the sex ratios found on Tables 3 and 4, is significantly different than 1:1 M/F (Yates corrected Chi Square statistic). The sex ratio of gizzard shad at the three stations varied from 1.15 to 2.50. The greatest deviation from 1 found at station 2 was found in the smallest samples where variance would be the greatest. Using our criteria for sex determination, there is no indication of aberant sex ratios in the few species that occur at all stations.

DISCUSSION:

The water quality of the Great Miami River is variable depending upon location from above Dayton to the Ohio River, where numerous industrial and sewage effluents enter the river. These have impacted the macroinvertebrates and the fishery of the Great Miami River. During the period 1978-1979 ORSANCO monitors at river mile 5.5 at Elizabethtown recorded cyanide violations of ORSANCO criteria on 6/35 samples, of mercury on 1/23 samples, phenolics on 7/36 samples, and lead on 9/23 samples (ORSANCO 1980). This number of violations is less on average than the number of violations in the Ohio River below the Cincinnati sewage and industrial effluents. The river section based on existing samples is the section below Dayton STP to Chautauqua Dam (RM 6075) is the most polluted with sewage plant effluents from Dayton, West Carrollton and Miamisburg and industrial wastes. Middletown and Hamilton STP and ARMCO Steel and other discharges below these sites have influence river quality negatively, but are less well studied.

In the period 1957-1959, fish sampling from the Ohio River turned up 83 species in lock and dam studies, while tributary sampling with many, many fewer individuals turned up more species, 108 spp. (ORSANCO 1962). Only paddlefish, mooneye, blue sucker, bigmouth buffalo , black buffalo, speckled shiner and yellow bass found in the mainstem were not found in tributary streams. However 24 species not found in the Ohio River were taken in tributary streams, mostly redhorses, chubs and darters. These fish require stream habitat and rocky substrates.

Since 1964 the high dams on the Ohio River have elevated the navigational pool from 3' to 9'. This raised water level in the Great Miami River, turning its mouth more and more into a backwater estuary at high water. These embayments have become habitat for pond fishes, largemouth bass and sunfishes. In the period 1968-1970 in annual lock rotenone samples 22, 18, and 18 species of fish were taken in one day samples(Preston 1975). The middle Ohio River has had about 120 species of fish identified up to 1983, most of which would be rare. The fishes of the Ohio River that are most common in order are the gizzard shad, the freshwater drum, the channel catfish and white crappie in lock rotenone samples in 1978-1980 (ORM 400-500)(with skipjack herring, carp, smallmouth buffalo, white bass, sauger increasing over the period 1957-1980(Pearson and Krumholz 1979). Twenty-two species of fish were enumerated between 1974 and 1980 in single day samplings of form 2100 to 3700 fish. Thus the Ohio River is one major source influencing the Great Miami River fish fauna between GMRM

In a comparably-sized tributary river, the Wabash River, the number of species of fish caught by electroshocking varied from 13 to 22 in unhealthy to healthy sections of the lower river, respectively (Gammon et al. 1981). We have found 12-15 spp., 11-19 spp., 12-16 spp, and 10-11 spp. at three stations samples once in September of 1984, 1985, 1986, and 1987, respectively. The cumulative number of species found in those annual surveys totaled 23 spp., 24 spp., and 19 spp. in 1985, 1986, and 1987 respectively. Thus the diversity in the GMR is comparable to a comparable industrial-agricultural river in Indiana.

The diversity of fish in mainstrem rivers like the Ohio, the Great Miami River and the Wabash River is maintained by the ability of fishes to move into refugia in tributary streams during pollutional event or period of oxygen stress (Riedy 1979). Normally, tributary streams are less diverse than mainstem river channels; however in the Wabash system 26 of the 35 mainstem species were collected at one time in tributary streams seeking refuge from pollutional episodes. Thus the Great Miami River might serve as a refuge for Ohio River fishes during pollutional or low oxygen episoded below Cincinnati. Similarly, smaller tributary streams of the Great Miami River, might serve as refugia during episodes passing down that river from the industrial sections below Dayton and Hamilton.

Biological surveys of fish and macroinvertebrates of the Great Miami River are few but relevant to interpreting our data. Osburn (1901 in Gammon) collected from the Stillwater and Wolf Creeks in 1901 collecting 39 species of fish. Between 1940-1950 Troutman (1957) collected the area finding 50 species. Scott (1969) electrofished and trapped at 7 stations in 111 miles of river in 1968. Conn(1971-1973) collecting in Montgomery County stations, Stillwater River(29 stations)(Conn 1971), Mad River(16 stations)(Conn 1972) and Wolf Creek found 44 species of fish. In the GMR from Piqua Dam to Hamilton STP in 1972 Conn (1973) collected 38 species of fish. Most recently, Gammon (1977) found 40 species of fish at 16 stations between GMRM 58-88.7 including Stillwater River, Great Miami River, and Mad Rivers above Dayton in mid June, late July, late Aug. and late Sept, 1976. In rank order, the commonest species were the longear sunfish, green sunfish, carp, stoneroller, samllmouth bass, gizzard shad, rock bass, goldfish, golden redhorse, ahd hog sucker. These 10 species made up 76.4% of the total catch by numbers. The worst section of river was the section below Dayton Sewage Treatment Plant (RM 75) to Chautaugua Dam (RM 61.7) when cap, goldfish, carp/goldfish hybrids and white suckers were the only fish present. Recovery began by RM 58 at Franklin when 10-12 species were collected per trip and collectively 15-20 species in four trips. Unfortunately the substrate dwelling macroinvertebrates collected at the same times on Dendy plate samplers did not recover. Species richness of invertebrates was down by half from that found above Dayton, although dominance by a single species had been reduced (Beckett et al. 1976).

In a more recent study of carp along the GMR between Taylorsville(RM 91.5) above Dayton to below Hamilton(RM 32.5) Moller (1986) electoshocked from 1 to 11 species of fish on single dates in 1982. The least diverse station (carp only) was RM64 at Hutchins Power Plant while the most diverse (11 species) were stations were above Dayton and Hamilton Dam (RM 36.7). The species he captured in a study of carp physiology, not community structure, contained mostly species found in the Fernald study except for some sunfish and shiners. His cumulative total for 10 stations was 22 species of which the carp, gizzard shad, common white sucker were the most ubiquitous (found at 8-10 stations). Although these studies were located above our section (GMRM 19-28), the diversity of fishes was similar. The dominants in the main river upstream, but not in larger tributaries, were similar to what we found in the lower river.

The species richness in rivers is a function of the total sample size or duration of sample efforts over several months or years. Larger or cumulative samples gather more fish than smaller or one-time samples. Hence the cumulative number of species identified by all workers prior to 1980 was 70 species. A figure comparing the species richness should be a comparison per unit effort or km of shoreline collected. Or a diversity index might used that is independent of sample size. This would measure the number of species per individual on average, baised by redunancy and species richness. However, our finding of 20-22 species on a single date at three stations is consistent with findings of these other studies.

For purposes of the user, fish are classed by ecological and sport/commercial value as forage A(minnows,shiners, chubs); forage B (shad and herrings); Sport A(sunfish and basses); Sport B(walleye, sauger, and perch); Commercial (channel catfish, blue catfish, buffalofishes, and freshwater drum) and Rough (carp, bullhead, and suckers)(Preston and White 1978). However, this pragmatic classification of fish based upon their use by man and their 'apparent' value is not an ecological classification that is relevant to their abundance and dominance in nature. Fish food webs must obey the same constraints as any food web. That is, to support a prized predatory fish at the top of a food web it takes an order of magnitude more production or biomass at each successively lower trophic step. Hence, a balanced fish community will be biased by large number or biomass of species that use detritus or detritus and invertebrates as their primary food if they are bottom feeders or those that use plankton or drift if they are open water feeders. In large rivers increasingly the latter openwater planktivores become more common. As rivers become very large and silted the mud/detritus bottom feeders become prominent. The former are gizzard shad and the latter are carp in the Great Miami River. They do not necessarily mean the river is polluted, only that the food resources has changed and/or the rocky shoals for breeding have been silted. The predatory piscivorous sauger, large and small mouth basses, striped bass, and white bass are predators prefered by fishermen. Although present their numbers and biomass should be considerably less than those species a the base of the food chain. Predators tend to be more sensitive to pollutants, toxic xenobiotics, and insecticides than other fish because of their higher metabolism and food-chain position. There were predators present in all of our samples.

Overall, their is a gradient in the river from upstream fish communities to downstream. However, sex ratios, length-frequency comparisons, and trophic structures are all consistent with normally healthy fish populations. The number of species per station was slightly lower than previous years, particularly at station 3. However, the elimination of a fish barrier, the dam protecting a surface gas line, has been removed so that even at late summer fish can move freely up and down river, selecting the habitat most advantageous to them. This has reduced the artificially high density and diversity found in 1986 at Welch's Sand and Gravel.

RECOMMENDATIONS

This survey on one day at three stations, selected for proximity to effluents of interest for potential radionuclide contamination, does not allow much confidence in extending these results to the whole river. What pollution that occurs upstream from theses sites may influence all of our pools. Samples sizes are small and survey only one season. Moreover, in selecting fish for analysis, the tendency is to take larger individuals and novel species. Common and small fish are often overlooked in selecting which fish to collect. The collection could be redesigned to some advantage. In the first place, comparable habitats should be examined. For nuclide concentrations, depositional environments in deep still pools might be the best. For maximal fish diversity riffles and fast sections may be best. Most important in any section is the complexity of shoreline and covering by trees near shore line (riparian vegetation). Many species of darters, sculpin, and chubs are only found in fast riffles, not sampled at all in our collections except by accident.

For maximal return on investment, an expansion should include an upstream survey sampling every 2-5 miles in comparable habitats done, at least, twice during the year (early and late summer). Moreover the number of sites in the intensive survey should be expanded from 3 to comparable habitats of each outfall station in the other sections. Station 2 is a fast deep section;

scanning fish for wounds, scars, parasites, developmental anomalies suggestive of pollution, and tumors. These non lethal, morphologically observable traits correlate highly with water quality in the Great Miami River (Moller 1986). Breeding condition, not so much sex determination per se, is of more biological relevance.

Sampling the fish community of the Great Miami River for radionuclides is one problem that could be directed to what is the risk to man, the fisherperson, or to the environment. In the latter case it could be directed to the biogeochemical cycling of which the fish and invertebrates are a part. Some radionuclides replace other elements in the physiology of fish. For example, Strontium^{90} is concentrated in bone. Zinc^{65} had biological half life of 8 days in algae, 50-68 days in crustacea, and 50 days in shiner perch in the Alder Slough of Columbia River (Renfro 1972). Since most of radionuclide contamination of the surface water at WIMCO is alpha and beta emitters (site W-2) (Aas et al. 1986), the determination and food chain concentrations of these might be as fruitful for examining the distribution and movement in Great Miami River biota. Obviously untangling the food web of a large river using radionuclides is much more costly, it would be a first for midwestern river. A better study would examine delivery form of the radionuclides, sorbtion onto silts or uptake from solution by algae, filtration by trichoptera or feeding by grazing chironomids, mayflies,etc., concentration in fish as function of size and feeding habits. The feasibility of such as study would require a pilot study to determine the minimal number of organisms for quantification of nuclides. Studies at this level have been undertaken by NRC facilities at Hanford, WA, Savannah, GA, Oak Ridge, TN, Brookhave, NY, and Argonne, IL. Longterm burial, leakage, and volume of material processes might indicate the need for similar studies in the environment of the nuclide-handling facility here at Fernald, OH.

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... at three station near Westinghouse Materials Company of Ohio.

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Fernald Survey 1987

Table : Numbers of fish by family and species electrofished from Great Miami River, 10 Sept. 1987 at three stations near Westinghouse Materials Company

Family	Code #	Common Name	Species Name	NUMBERS COLLECTED PER STATION 'I'	'II'	'III'
Clupeidae	1	GIZZARD SHAD	Dorosoma cepedianum	36	11	93
Cyprinidae	2	CARP	Cyprinus carpio	6	3	3
Cyprinidae	12	CHANNEL MIMIC SHINER	Notropis volucellus	0	0	13
Castostomidae	13	RIVER CARPSUCKER	Carpiodes carpio	0	2	1
Catostomidae	9	LONG FIN CARPSUCKER	Carpiodes velifer	1	0	0
Catostomidae	24	NORTHERN HOGNOSE SUCKER	Hypentelium nigricans	0	1	0
Catostomidae	21	GOLDEN REDHORSE	Moxostoma duquesnei	0	6	0
Catostomidae	30	BLACK REDHORSE	Moxostoma duquesnei	1	1	0
Catostomidae	8	SUCKERMOUTH MINNOW	Phenacobius mirabilis	0	0	4
Ictaluridae	23	YELLOW BULLHEAD CATFISH	Ictalurus natalis	1	0	0
Ictaluridae	15	CHANNEL CATFISH	Ictalurus punctatus	0	3	1
Percichthyidae	10	WHITE BASS	Marone chrysops	0	0	0
Centrarchidae	7	SUNFISH	Lepomis hybrid unident.	0	0	2
Centrarchidae	5	BLUEGILL SUNFISH	Lepomis macrochirus	1	0	0
Centrarchidae	4	SMALL MOUTH BASS	Micropterus dolomieui	1	2	0
Centrarchidae	3	LARGE MOUTH BASS	Micropterus salmoides	2	0	2
Centrarchidae	6	WHITE CRAPPIE	Pomoxis annularis	0	0	1
Percidae	11	SAUGER	Stizostedion canadense	1	2	0
Sciaenidae	18	DRUM	Aplodinatus gunniens	0	18	0
Serranidae	17	STRIPPED BASS	Morone saxatilis	1	7	2

					Sum(1,2,&3)
Total Fish Enumerated		51	56	122	229
DIVERSITY (Ln2)	J =	1.680	3.073	1.398	
SPECIES NUMBER	s =	10	11	10	
MAXIMAL DIVERSITY POSSIBLE		3.322	3.459	3.322	
EVENESS	E =	0.506	0.888	0.421	
		1	2	3	
		Boulton	Outfall	Paddy's	
Number of fish collected for harvest		50	46	99	
Average length of fish (cm)		274	295	229	cm/avg.fish
Average weight of fish (gm)		345	378	147	gm/avg.fish
Meters of fish/station		13.7	13.6	22.7	meters all fish
Total Weight of fish/station (KG)		17.3	17.4	14.6	kilograms all fish

007300

F	2	24	504	350
M	2	2	1850	540
F	2	2	1415	440
M	2	2	880	425
M	2	15	561	390
M	2	15	556	405
M	2	15	312	330
M	2	11	433	360
M	2	11	200	295
M	2	17	382	305
M	2	17	472	328
M	2	17	284	280
M	2	17	352	300
M	2	17	140	230
I	2	17	126	220
I	2	17	148	235
I	2	4	22	120
I	2	4	17	115
M	2	18	352	300
I	2	18	186	270
F	2	18	244	273
F	2	18	154	228
I	2	18	122	215
I	2	18	90	197
I	2	18	64	171
F	2	18	162	235
F	2	1	246	292
F	2	1	280	300
M	2	1	138	234
M	2	1	164	240
M	2	1	168	245
I	2	1	156	244
M	2	1	182	257
M	2	1	156	242
I	2	1	146	233
I	2	1	98	205
I	2	1	128	216
I	3	1	142	230
I	3	1	130	234
I	3	1	91	205
I	3	1	98	207
I	3	1	142	223
I	3	1	140	217
I	3	1	108	203
I	3	1	84	190
I	3	1	74	183
I	3	1	124	217
M	3	1	160	230
M	3	1	178	240
I	3	1	121	217
I	3	1	86	184
I	3	1	98	197
I	3	1	16	115
I	3	1	120	215
M	3	1	144	230
M	3	1	168	240
M	3	1	178	250
M	3	1	132	225
M	3	1	136	225
M	3	2	158	235
M	3	1	154	240
M	3	1	136	225
I	3	1	122	218
I	3	1	24	125
I	3	1	88	199

000022

Table 1:Fish Electroshocked from the Great Miami River on Sept. 10, 1987
below Ross(#1),below New Baltimore(#2) and above Miamitown(#3).

FISH IN GREAT MIAMI RIVER . 10 Sept.

SEX	SITE	SPECIES	WT	LENGTH
M	1	3	400	325
M	1	3	380	300
	1	9	378	300
M	1	11	264	320
M	1	23	50	180
F	1	17	264	275
M	1	2	260	260
F	1	2	975	423
M	1	2	1427	480
F	1	2	2676	575
F	1	2	962	455
F	1	2	2132	520
F	1	30	663	401
I	1	4	10	90
I	1	5	6	78
	1	1	158	235
	1	1	278	280
gizzard	1	1	210	262
shad	1	1	242	284
13 F	1	1	172	244
15 M	1	1	138	232
8 I	1	1	172	242
	1	1	195	260
	1	1	240	272
	1	1	120	220
	1	1	182	255
	1	1	193	253
	1	1	152	224
	1	1	241	276
	1	1	178	240
	1	1	130	222
	1	1	190	245
	1	1	178	248
	1	1	111	220
	1	1	180	240
	1	1	172	245
	1	1	140	227
	1	1	230	263
	1	1	178	248
	1	1	141	225
	1	1	221	273
	1	1	183	253
	1	1	222	276
	1	1	156	235
	1	1	181	248
	1	1	198	261
	1	1	222	280
	1	1	152	240
	1	1	200	255
	1	1	156	234
F	2	21	710	385
M	2	21	622	355
M	2	21	395	330
F	2	21	745	395
M	2	21	512	355
M	2	21	478	345
F	2	30	950	465
M	2	13	454	340

FISH SPECIES CODES

1 GIZZARD SHAD
2 CYPRINUS CARPIO
3 LARGE MOUTH BASS
4 SMALL MOUTH BASS
5 BLUEGILL SUNFISH
6 White Crappie
7 Sunfish
8 Sucker Mouth Minnow
9 LONG FIN CARPSUCKER
10 WHITE BASS
11 SAUGER
12 Mimic Shiner
13 RIVER CARPSUCKER
15 CHANNEL CATFISH
17 STRIPPED BASS
18 DRUM
21 golden redhorse
23 YELLOW BULLHEAD
24 northern hog sucker
30 Black Redhorse

No. fish collected and identified:

1 to 30 are species codes
species in list to left.

site #1: Great Miami River below Ross bridge.
Boulton Water Treatment Plant
Site #2: Great Miami River below New Baltimore Bridge.
Strickers Grove
Site #3: Great Miami River above Miamitown bridge
at Bennett Gravel Quarry.
Paddy's Run from Fernald

007300

F	3	1	104	207
M	3	1	[illegible]	[illegible]
M	3	1	136	230
I	3	1	126	220
I	3	1	74	187
I	3	1	28	135
I	3	1	12	107
I	3	1	60	197
M	3	1	145	228
I	3	1	136	232
I	3	1	100	220
M	3	1	142	230
F	3	1	140	218
M	3	1	142	230
F	3	1	140	245
M	3	1	168	245
M	3	1	160	240
M	3	1	140	240
M	3	1	132	232
M	3	1	138	245
I	3	1	128	222
M	3	1	124	232
I	3	1	100	210
F	3	1	202	260
I	3	1	142	245
M	3	1	188	260
M	3	1	132	233
I	3	1	110	230
M	3	1	132	225
M	3	1	134	225
M	3	1	140	230
M	3	1	131	228
M	3	1	160	230
M	3	1	166	245
M	3	1	200	255
F	3	1	243	290
M	3	1	168	242
F	3	1	194	260
F	3	1	228	273
F	3	1	104	210
F	3	1	189	270
F	3	1	210	265
F	3	1	218	275
F	3	1	132	230
F	3	1	136	235
M	3	1	154	239
F	3	1	180	250
M	3	1	120	223
M	3	1	108	217
F	3	1	150	245
M	3	1	164	235
I	3	1	154	242
F	3	1	126	225
F	3	1	172	262
M	3	1	161	248
F	3	1	201	263
F	3	1	118	212
F	3	1	130	225
F	3	1	198	255
F	3	1	161	255
M	3	1	160	242
F	3	1	134	235
M	3	1	164	242
F	3	1	184	257
F	3	1	124	217
F	3	15	[illegible]	[illegible]

000024

F	3	3	610	340
M	[illegible]	[illegible]	11[illegible]	[illegible]
F	3	17	244	278
M	3	13	340	305
I	3	17	22	124

Seen but not captured station 3;
3 Large carp 2-3 lbs
Black Crappie 25 cm

Fernald Survey 1987

Table 3. Sex ratios of dominant species summed for three stations, GMR 1987

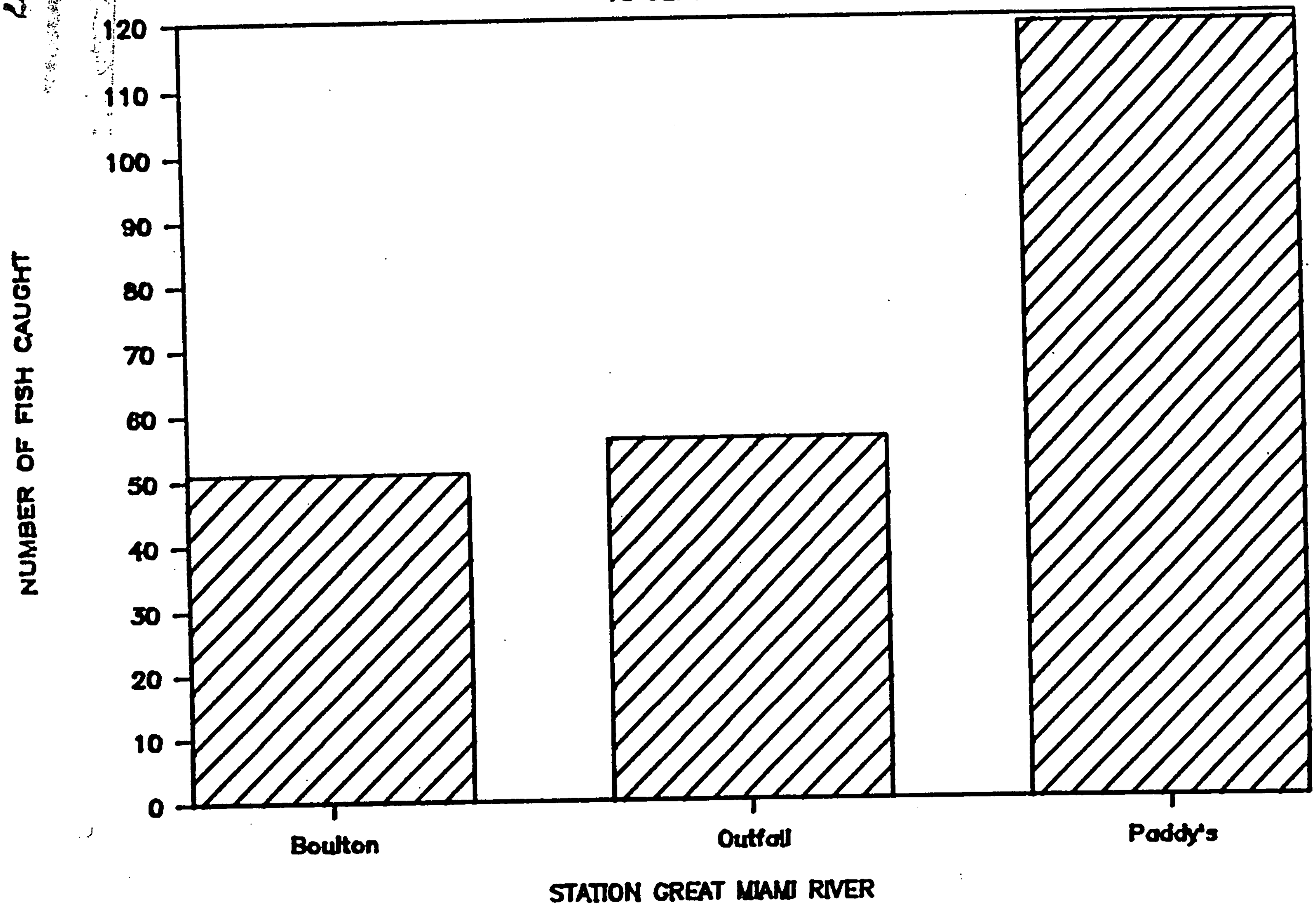
Species	Male	Female	Immature	Sex ratio male/female
SHAD	57	39	43	1.462
CARP	5	5	0	1.000
CATOSTOM.	6	6	0	1.000
ST. BASS	5	2	3	2.500

Table 4. Sex ratios of Gizzard Shad by station, GMR 1987

Station	Male	Female	Immature	Sex ratio Male/Female
1	15	13	8	1.154
2	5	2	4	2.500
3	38	24	31	1.583

TOTAL FISH CAUGHT IN GREAT MIAMI R.

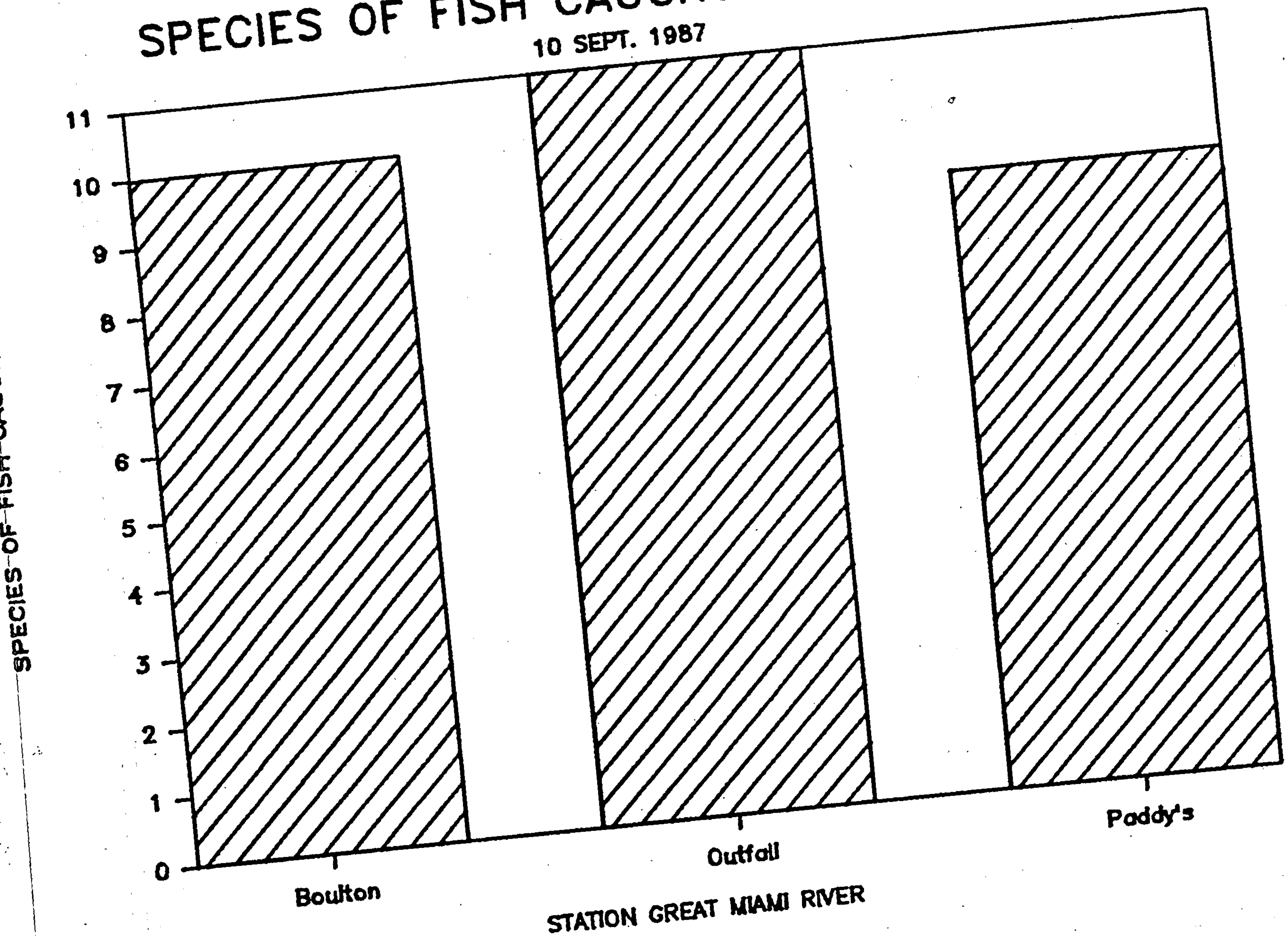
10 SEPT. 1987

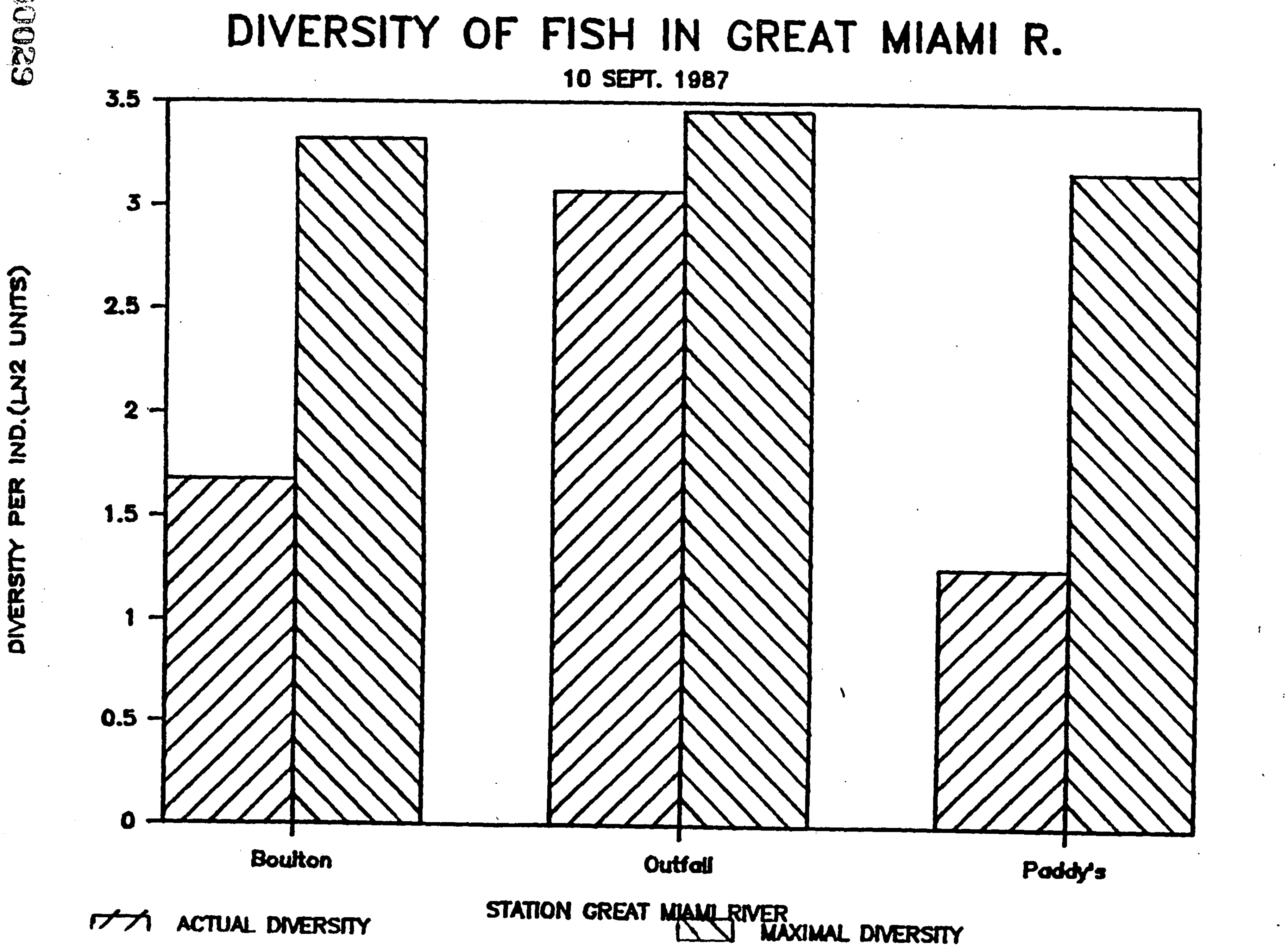


000027

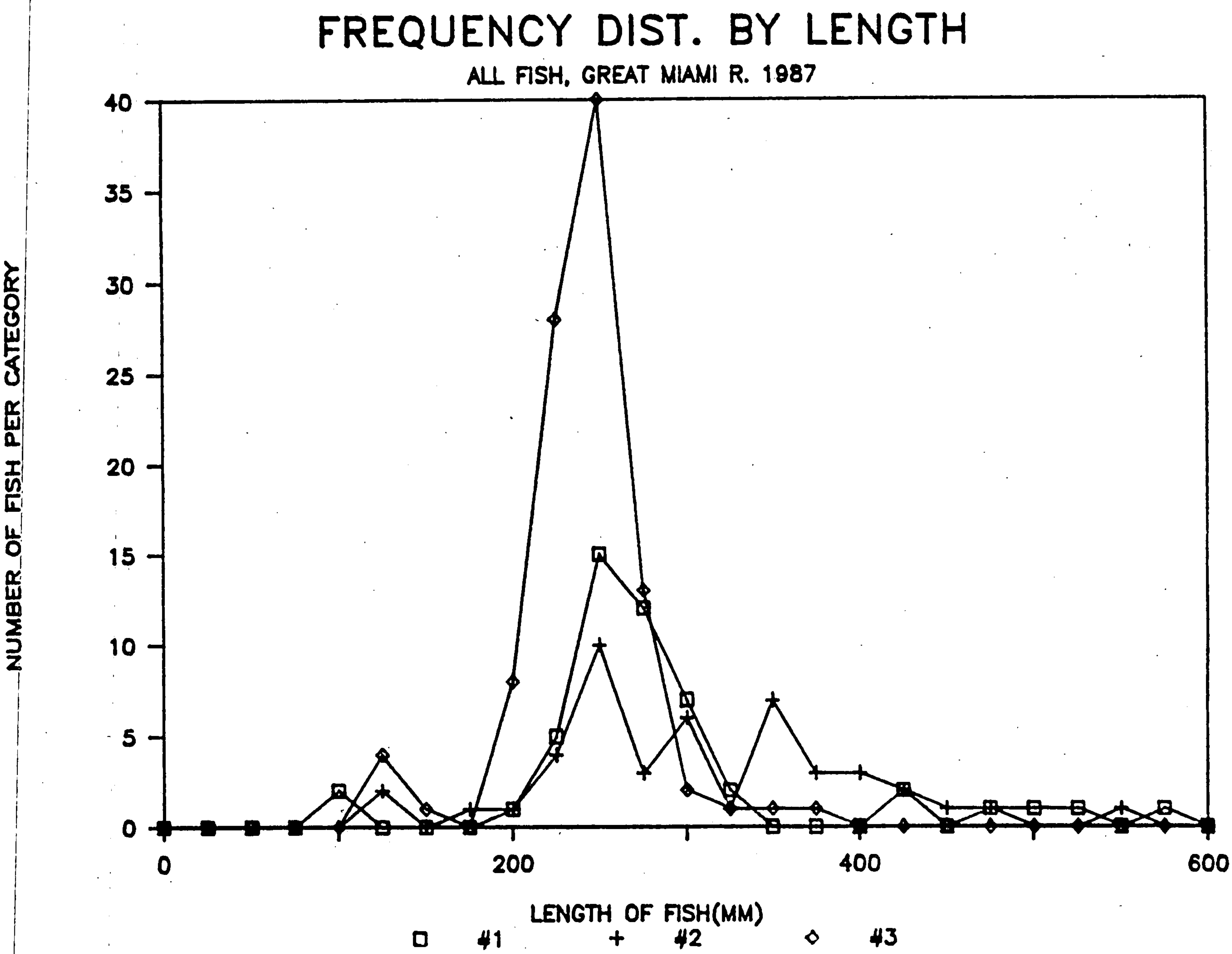
SPECIES OF FISH CAUGHT IN GR.MIAMI R.

10 SEPT. 1987





DIVERSITY OF FISH IN GREAT MIAMI R.
10 SEPT. 1987
DIVERSITY PER IND.(LN2 UNITS)
3.5
3
2.5
2
1.5
1
0.5
0
Boulton
Outfall
Paddy's
STATION GREAT MIAMI RIVER
ACTUAL DIVERSITY
MAXIMAL DIVERSITY

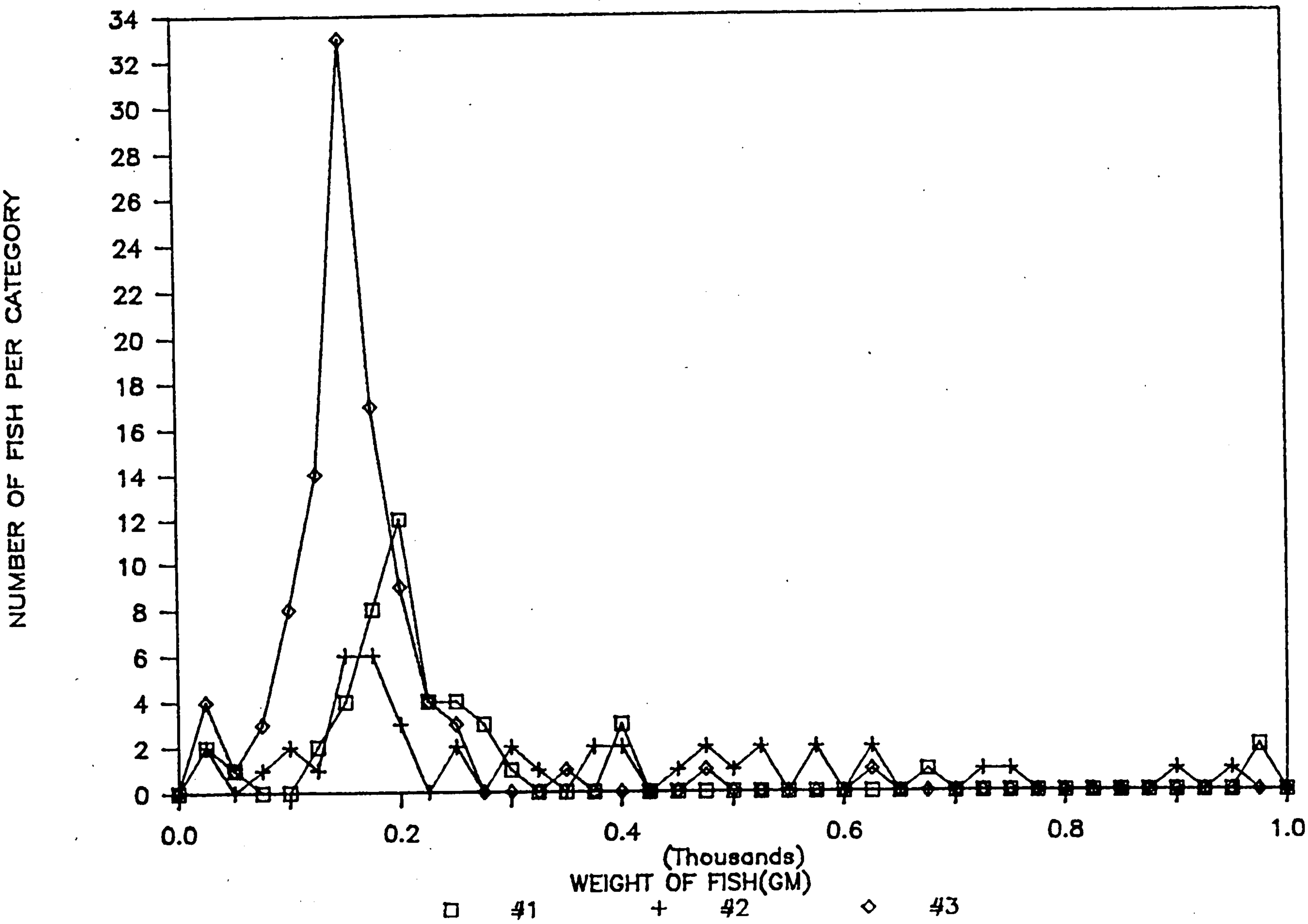


0000030

0007300

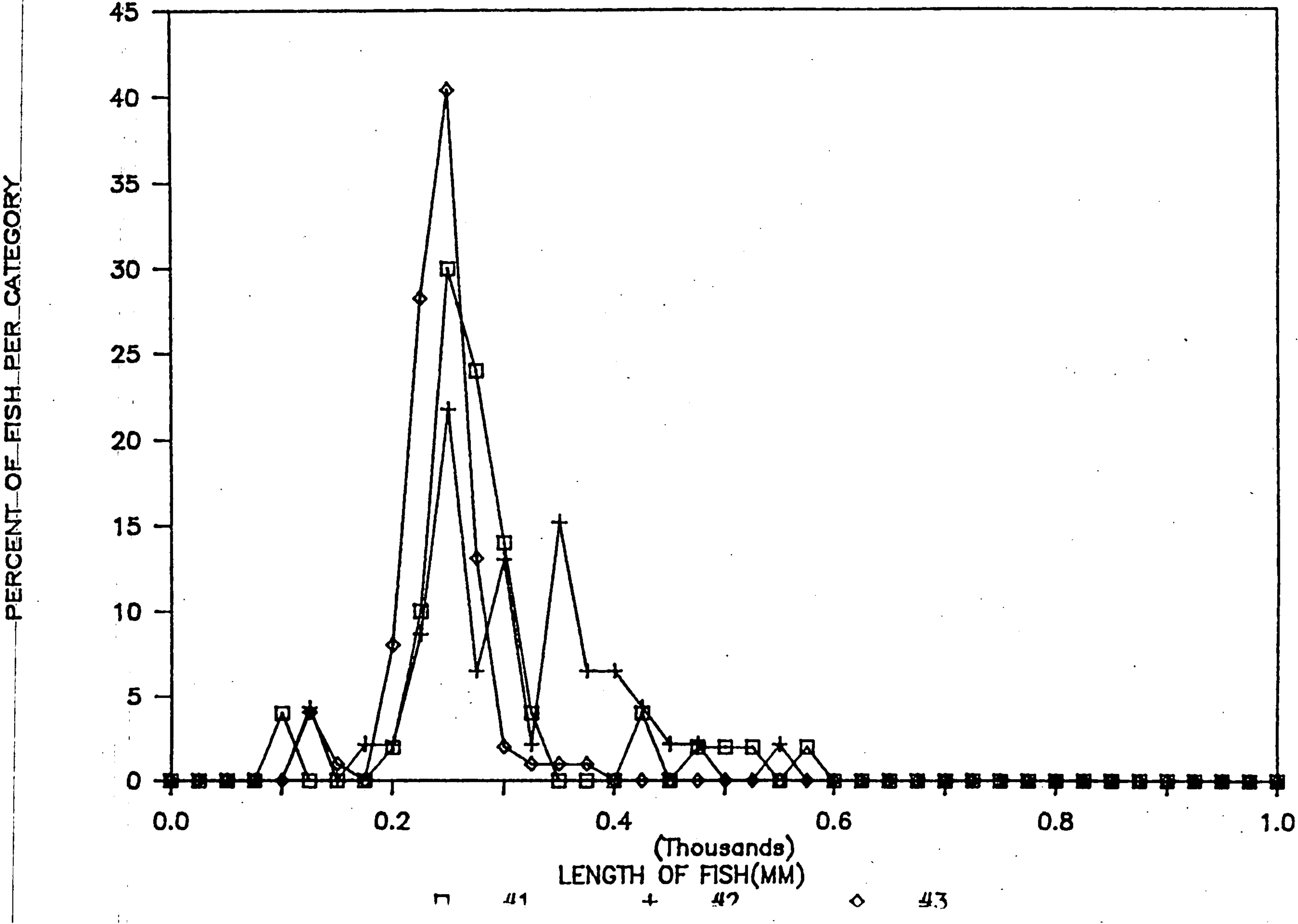
FREQUENCY DIST. BY WEIGHT

ALL FISH, GREAT MIAMI R. 1987



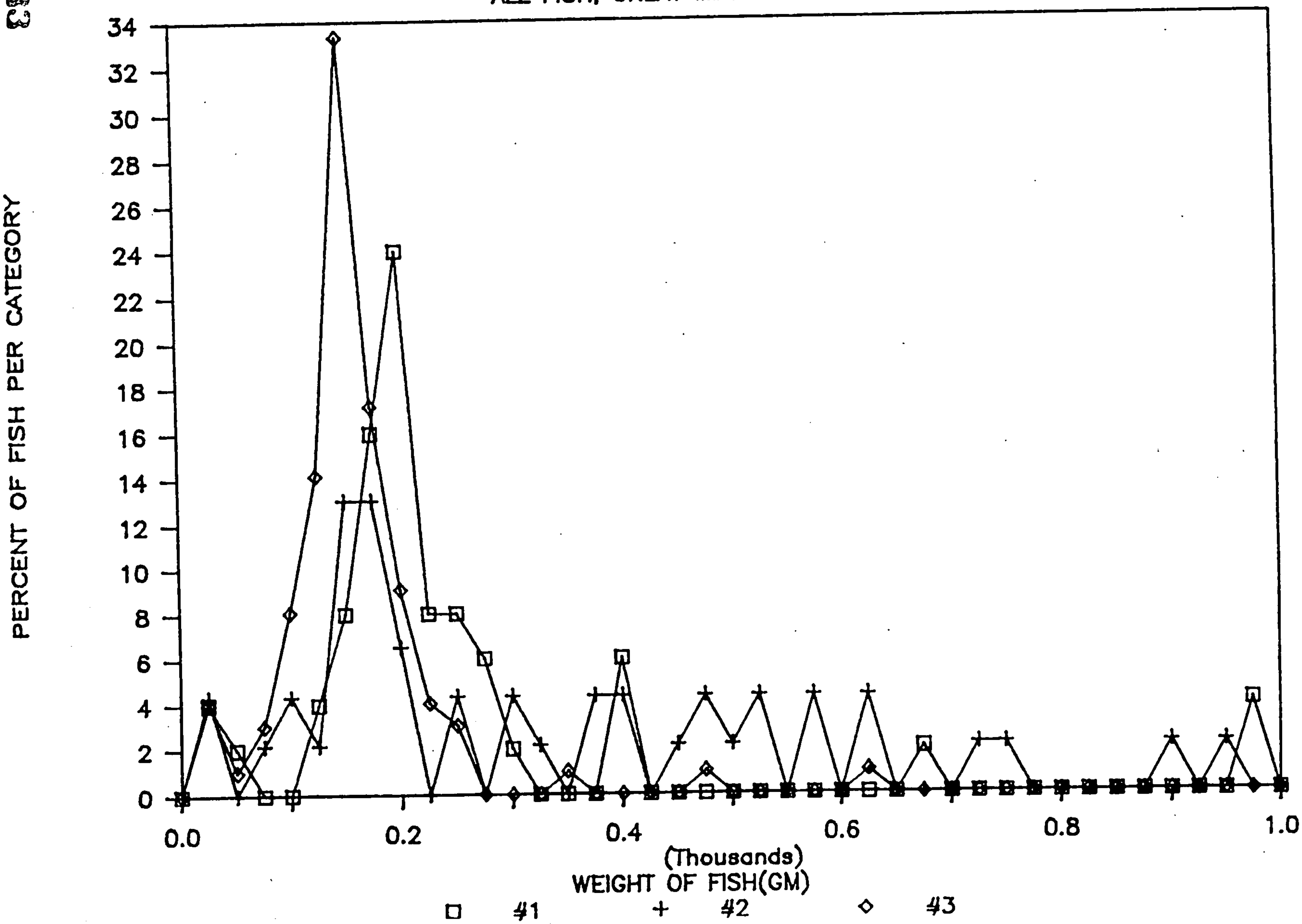
PERCENT FREQUENCY DIST. BY LENGTH

ALL FISH, GREAT MIAMI R. 1987



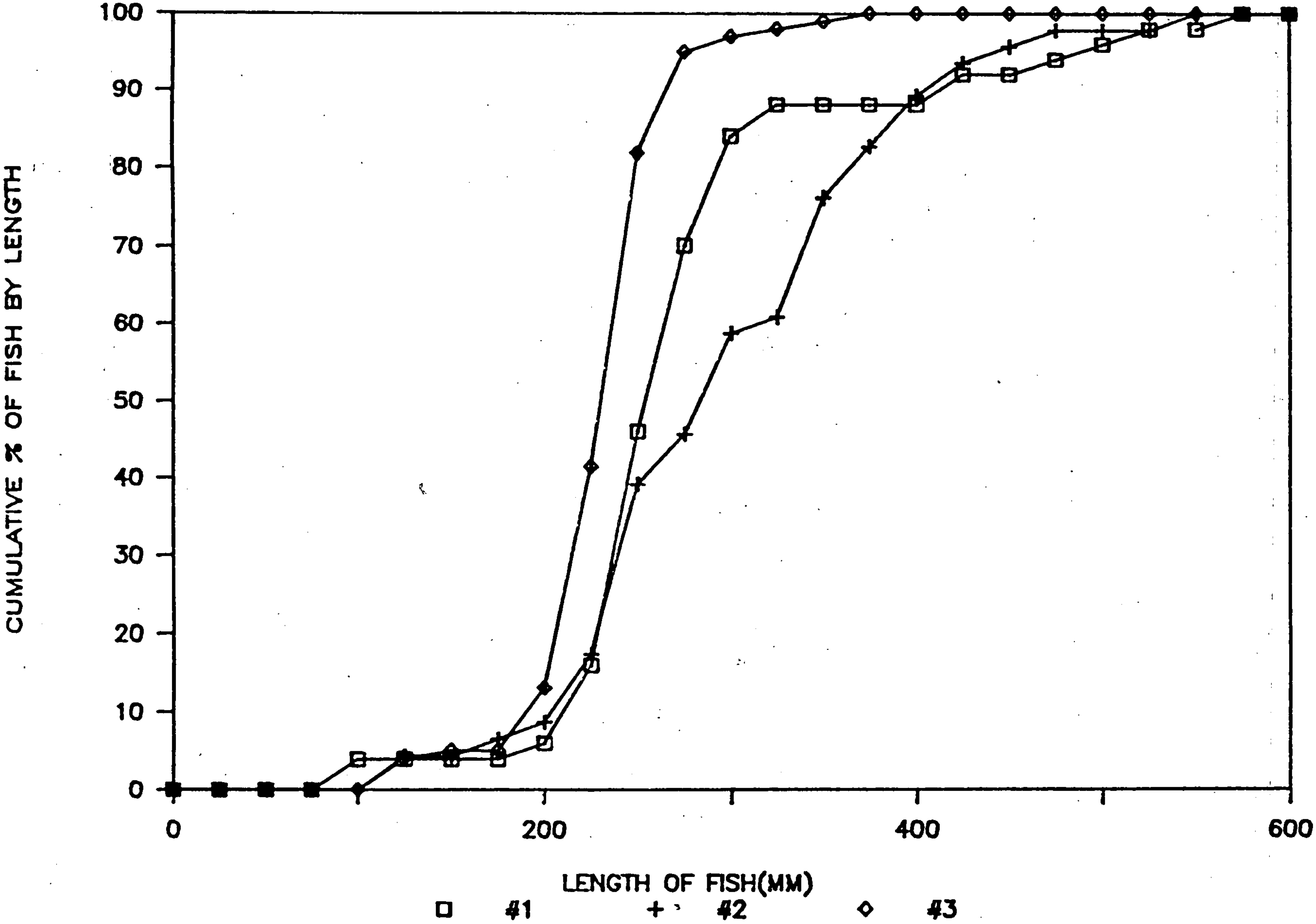
PERCENT FREQUENCY DIST. BY WEIGHT

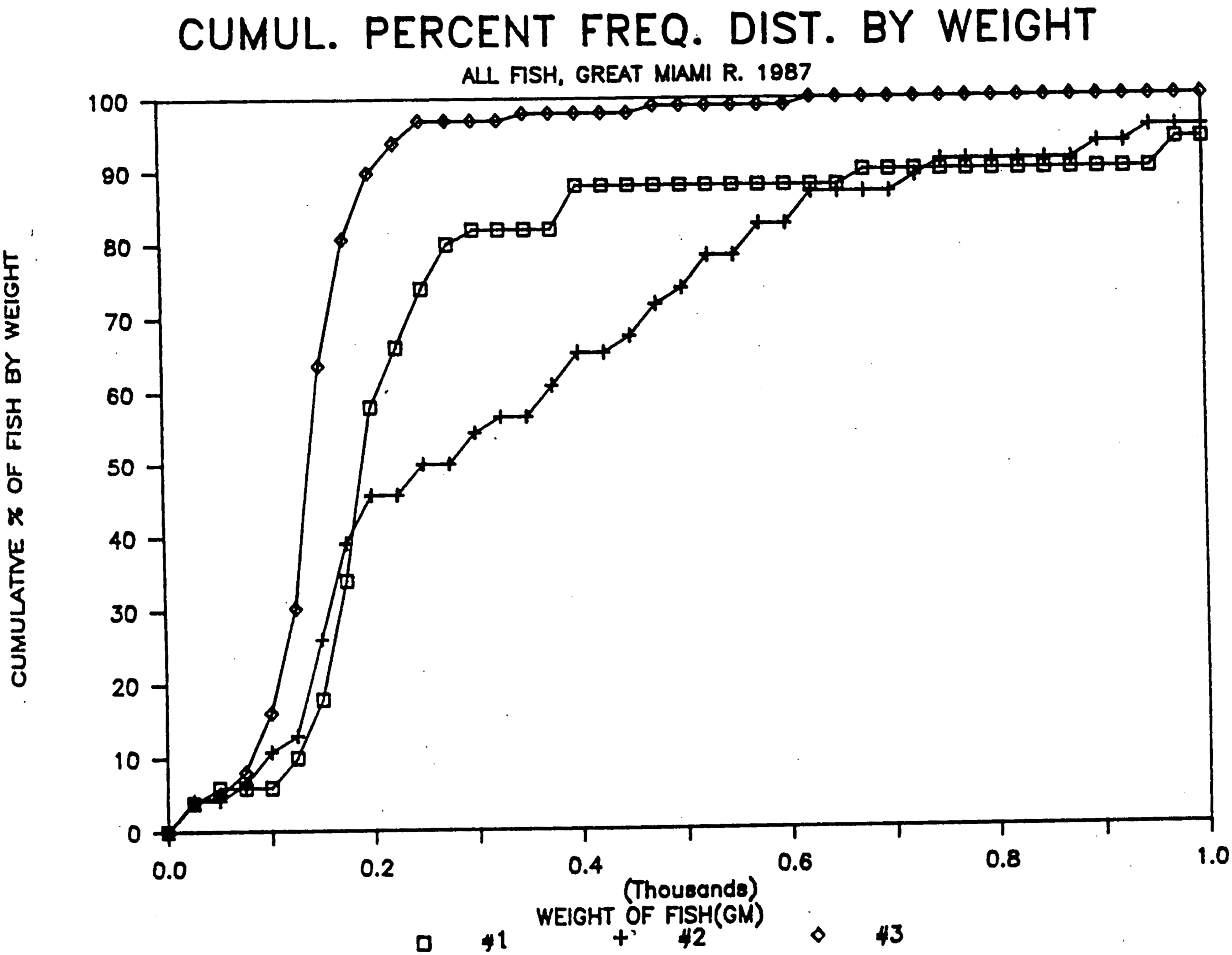
ALL FISH, GREAT MIAMI R. 1987



CUMUL. PERCENT FREQ. DIST. BY LENGTH

ALL FISH, GREAT MIAMI R. 1987

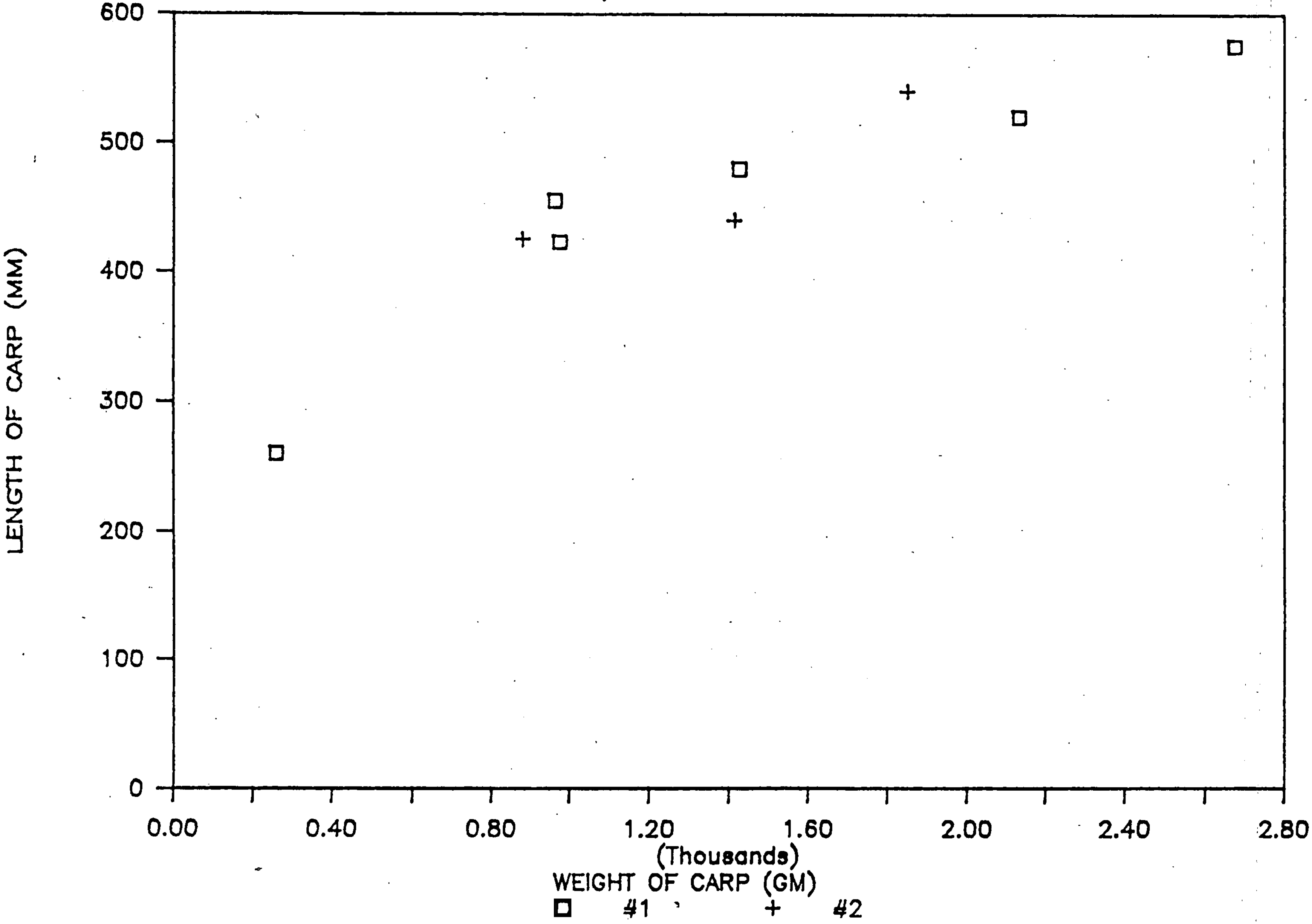



CUMUL. PERCENT FREQ. DIST. BY WEIGHT
ALL FISH, GREAT MIAMI R. 1987
CUMULATIVE % OF FISH BY WEIGHT
100
90
80
70
60
50
40
30
20
10
0
0.0
0.2
0.4
0.6
0.8
1.0
(Thousands)
WEIGHT OF FISH(GM)
#1
#2
#3

000035

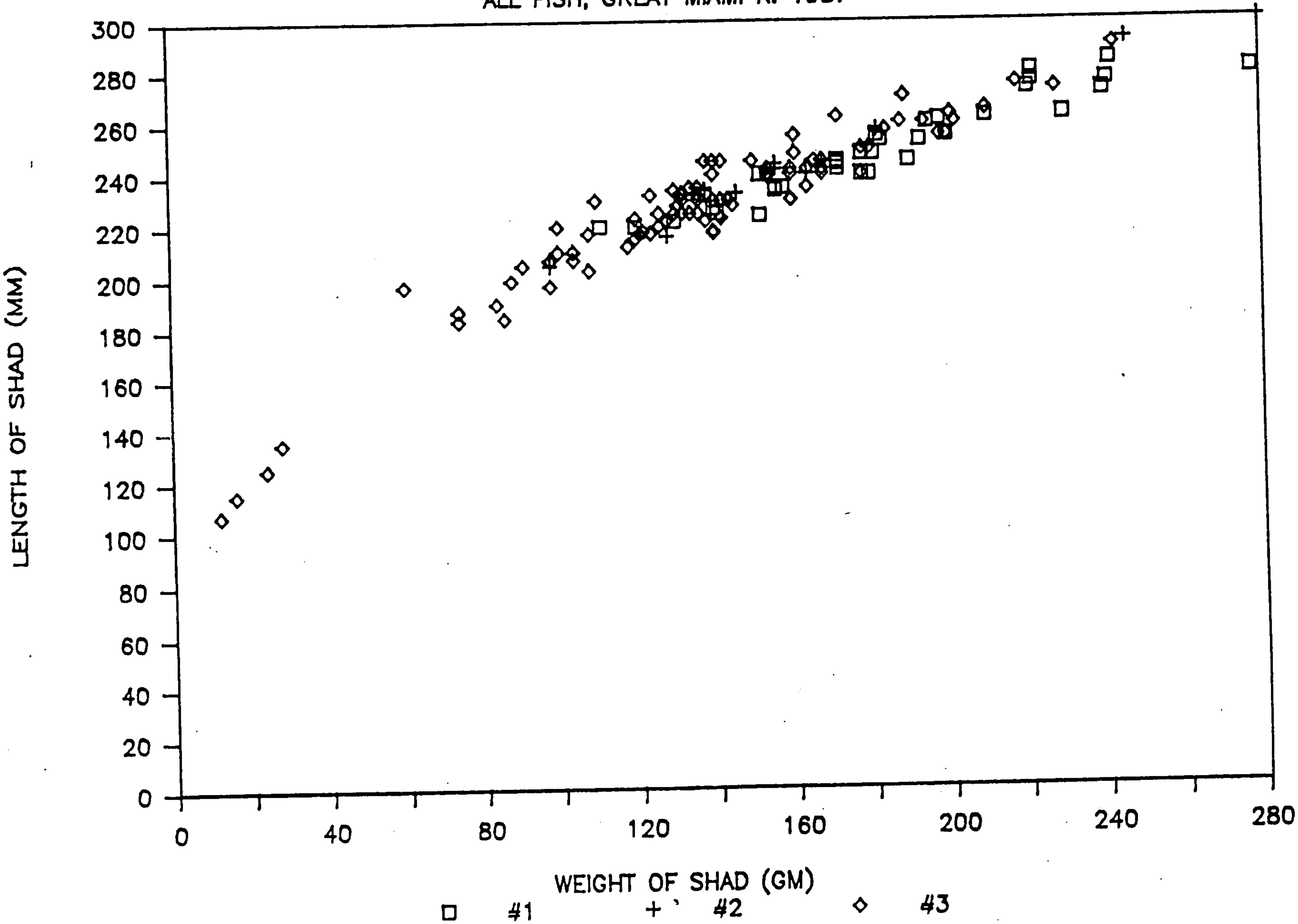
WEIGHT/LENGTH RELATIONSHIP OF CARP

ALL FISH, GREAT MIAMI R. 1987



WEIGHT/LENGTH RELATIONSHIP OF SHAD

ALL FISH, GREAT MIAMI R. 1987



000037

Inventory of packaged fish samples from Great Miami River, 1987

Station 3

Sample #	Weight (gm)	Sex	Species
1	526		Gizzard Shad
2	558		Gizzard Shad
3	576		Gizzard Shad
4	460		Gizzard Shad
5	44		Gizzard Shad
6	432	M	Gizzard Shad
7	570	M	Gizzard Shad
8	536	M	Gizzard Shad
9	556	M	Gizzard Shad
10	564	M	Gizzard Shad
11	545	M	Gizzard Shad
12	295	M	Gizzard Shad
13	420	M	Gizzard Shad
14	506	F	Gizzard Shad
15	352	F	Gizzard Shad
16	406	F	Gizzard Shad
17	416	F	Gizzard Shad
18	495	F	Gizzard Shad
19	592	F	Gizzard Shad
20	342	F	Channel Catfish
21	418	F	Large Mouth Bass
22	296		Mixed bass
23	242		Carpsuckers

Inventory of packaged fish samples from Great Miami River, 1987

Station 1

Sample #	Weight (gm)	Sex	Species
24	334		Gizzard Shad
25	376		Gizzard Shad
26	538	M	Gizzard Shad
27	466	M	Gizzard Shad
28	408	M	Gizzard Shad
29	484	F	Gizzard Shad
30	574	F	Gizzard Shad
31	444	F	Gizzard Shad
32	540		Large Mouth Bass
33	220		Sauger
34	848		Carpsucker
35	1315		Carp
36	574		Carp
37	1089		Carp
38	224		Mixed Bass
39	650		Carp
40	1415		Carp

Inventory of packaged fish samples from Great Miami River, 1987

Station 2

Sample #	Weight (gm)	Sex	Species
41	776		Carpsucker
42	480		Redhorse
43	512		Redhorse
44	770		Redhorse
45	784		Black Redhorse
46	628		Redhorse
47	508		Carp
48	674		Carp
49	971		Carp
50	510		Catfish
51	320		Channel catfish
52	324		Northern hogsucker
53	440		Drum
54	612		Drum
55	328	M	Gizzard Shad
56	550	F	Gizzard Shad
57	360		Gizzard Shad
58	476		Sauger
59	250		Striped Bass
60	590	M	Striped Bass
61	660	M	Striped Bass